

### 3. CHEMICAL AND PHYSICAL INFORMATION

#### 3.1 CHEMICAL IDENTITY

Used mineral-based crankcase oil is a complex mixture of low and high ( $C_{15}$ - $C_{50}$ ) molecular weight aliphatic and aromatic hydrocarbons, lubrication additives, metals, and various organic and inorganic compounds. The chemical composition of used mineral-based crankcase oil varies widely and depends on the original crude oil, the processes used during refining, the efficiency and type of engine the oil is lubricating, the gasoline combustion products, the additives added to the fuel and to the original oil, and the length of time that the oil remains in the engine. The oil is typically 73-80% weight/weight aliphatic hydrocarbons (primarily alkanes and cycloalkanes with 1-6 rings); 11-15% monoaromatic hydrocarbons; 2-5% diaromatic hydrocarbons; and 4-8% polyaromatic hydrocarbons (Vasquez-Duhalt 1989). The lubrication additives, which are approximately 20% of the oil, consist primarily of zinc diaryl, molybdenum disulfide, zinc dithiophosphate, metal soaps, and other organometallic compounds. Detergents and dispersants constitute 2-15% of the additives (Vasquez-Duhalt 1989).

Other compounds found in used mineral-based crankcase oil as a result of oil additives include barium, phosphorus, zinc, and some chlorine and bromine compounds (Vermont Agency of Natural Resources 1994). Additional organic and inorganic compounds found in used mineral-based crankcase oil are sulfur, aluminum, arsenic, calcium, chromium, copper, iron, magnesium, manganese, potassium, silicon, sodium, tin, toluene, benzene, xylene, ethylbenzene, and nitrogen, although most organic compounds are destroyed during combustion of used mineral-based crankcase oil as fuel (Canadian Environmental Protection Agency 1994; Vermont Agency of Natural Resources 1994).

Small amounts of PCBs were in the past incorporated into transmission fluids to control swelling of rubber seals (Mueller Associates 1987). PCBs were also detected in 4 of 24 used oil samples at concentrations of 7, 13, 18, and 65 ppm (Suprenant 1983). It should be noted that PCBs have never been used in lubricant additives or in the creation of new motor oils. Because dioxins can form from PCBs, which has severe health implications, production of PCBs for commercial purposes has almost ceased (Hewstone 1994b).

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Information regarding the chemical identity of used mineral-based crankcase oil is located in Table 3-1.

#### **3.2 PHYSICAL AND CHEMICAL PROPERTIES**

Information regarding the physical and chemical properties of used mineral-based crankcase oil is located in Table 3-2.

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**TABLE 3-1. Chemical Identity of Used Mineral-based Crankcase Oil *In Vitro***

Characteristic	Information	Reference
Chemical name	Mineral-based crankcase oil	DOE 1989
Synonym(s)	API 79-7; API service classification SAE 30 automotive motor oil; monograde automotive engine oil; multigrade automotive engine oil; marine engine oil; base engine oil; monograde diesel oil; railway diesel oil; marine diesel oil	American Petroleum Institute 1980; DOE 1989
Registered trade name(s)	No data	
Chemical formula	No data	
Chemical composition	Branched alkanes; cycloalkanes; benzenes and alkylbenzenes; naphthalenes; polynuclear aromatic hydrocarbons; linear alkanes; additives; decomposition products; and contaminants	DOE 1989
Identification numbers:		
CAS registry	8002-05-9	IARC 1984
NIOSH RTECS	No data	
EPA hazardous waste	No data	
OHM/TADS	No data	
DOT/UN/NA/IMCO shipping	No data	
HSDB	No data	
NCI	No data	

CAS = Chemical Abstracts Services; DOT/UN/NA/IMCO = Department of Transportation/United Nations/North America/International Maritime Dangerous Goods Code; EPA = Environmental Protection Agency; HSDB = Hazardous Substances Data Bank; NCI = National Cancer Institute; NIOSH = National Institute for Occupational Safety and Health; OHM/TADS = Oil and Hazardous Materials/Technical Assistance Data System; RTECS = Registry of Toxic Effects of Chemical Substances

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**TABLE 3-2. Physical and Chemical Properties of Used Mineral-based Crankcase Oil**

Property	Information	Reference
Molecular weight	No data	
Color	Yellow brown to black	DOE 1989
Physical state	Liquid, oily	DOE 1989
Melting point	-34.4°C	DOE 1989
Boiling point	360.0°C	DOE 1989
Density	Not applicable	
Viscosity: at 25°C	Variable	
Odor	Lube oil odor	DOE 1989
Odor threshold	No data	
Solubility:	No data	
Water at 20°C	Insoluble	DOE 1989
Organic solvent(s)	No data	
Partition coefficients:		
Log $K_{ow}$	No data	
Log $K_{oc}$	No data	
Vapor pressure at 20°C	No data	
Henry's law constant	No data	
Autoignition temperature	≥135°C	DOE 1989
Flashpoint	≥163°C	DOE 1989
Flammability limits	No data	
Conversion factors	No data	
Explosive limits	No data	